The life history of *Hypanartia dione dione* (Lepidoptera: Nymphalidae) in northeastern Ecuador.

Harold F. Greeney and Carina Chicaiza Aguirre
Yanayacu Biological Station and Center for Creative Studies, Cosanga, Ecuador c/o Foch 721 y Amazonas, Quito, Ecuador.
revmmoss@yahoo.com

Abstract. Little has been published on the natural history of the strictly Neotropical nymphalid genus *Hypanartia*. We describe, for the first time, the early stages of *Hypanartia dione dione* from rearings in eastern Ecuador. Plants from two genera, *Cecropia* (Cecropiaceae) and *Boehmeria* (Urticaceae), are used as larval food plants. Larvae construct and inhabit shelters on the food plant leaves which are similar in many respects to those built by some members of the family Hesperiidae. Larval coloration and general morphology are similar to *H. d. arcaei* from Costa Rica.

Key words: Andes, cloud forest, food plant, larva, pupa, shelter.

INTRODUCTION

The genus *Hypanartia* Hübner 1821 includes 14 species of nymphalid butterflies, all with orange, brown, or reddish ground colors to their angular and tailed wings. They are distributed throughout Central and South America, with the equatorial Andes as their center of diversity (Willmott *et al.*, 2001). The natural history of most species is poorly known, with published larval descriptions available for only four species (DeVries, 1987; Toledo, 1973; Wolcott, 1924; Young 1976). From these we know that the genus feeds predominantly on Urticaceae and Ulmaceae, with one record from Cuba of *H. paullus* (Fabricius, 1793) feeding on *Piper* (Piperaceae) (Alayo & Hernandez, 1987).

Hypanartia dione dione (Latreille, 1813) (Fig. 1) is one of three subspecies and is distributed throughout the Andes on both slopes from Venezuela to Ecuador and along the eastern slopes south to Argentina (Willmott *et al.*, 2001). Apart from photographs in Janzen and Hallwachs (2005), nothing has been published concerning the early stages of this species. Here we describe the larva, pupa, larval shelter building behavior, and host associations of *H. dione dione* from northeastern Ecuador.

MATERIALS AND METHODS

We made all collections in the vicinity of the Yanayacu Biological Station and Center for Creative Studies (YBS, 00°35.949 S, 77°53.403, 2100 m), located 5 km west of the town of Cosanga, Napo Province, eastern Ecuador. We collected larvae from the adjacent Hacienda San Isidro private reserve owned by the Bustamante family and along the Huacamayos ridge, 5 km to the south. On 6 November 2001, we collected one first and one second instar along a small stream in the San Isidro preserve at an elevation of approximately 2050 m. Additionally, we collected two egg shells from the bottom surface of the leaf. Subsequently, on 22 November, we collected one fourth instar, nine fifth instars, and two sixth instars at an elevation of approximately 2300 m along the Huacamayos ridge. We returned all larvae to YBS and reared them inside glass jars by providing fresh leaves every two days. In total, we reared six to eclosion. We made larval length measurements at the time of premolt or prepupa, when feeding had stopped. To avoid artifacts of enclosure, we only included observations of shelter building behavior and construction that were made in the field at the time of collection. We preserved one fifth instar, one sixth instar, and one pupa in 70% alcohol after dropping them into boiling water as described by DeVries (1987). Subsequently, we reared numerous individuals from three different host plants. All early stages and adult vouchers are retained in the first author's personal collection.

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RESULTS

Cecropia litoralis (Cecropiaceae), *Boehmeria caudata*, and *B. ulmifolia* (Urticaceae) are used as larval food plants by *Hypanartia d. dione* in our area. All instars rested in leaf shelters constructed by the larva. We never encountered frass inside shelters, yet larvae did not forcibly eject frass as described for shelter building

Figure 1. Adult *Hypanartia d. dione* puddling at urine enriched soil, Yanayacu Biological Station, Napo, Ecuador, 2100 m. Photo by H. F. Greeney.

Figures 2 - 4. Early stages of *Hypanartia d. dione* at the Yanayacu Biological Station, Napo, Ecuador, 2100 m. Photos by H. F. Greeney. **2**. Fifth instar. **3**. Pupa. 4. Leaf shelter of final instar.

Hesperiidae (Scoble, 1992; Weiss, 2003). As little has been written on nymphalid larval shelters, discussions and descriptions follow those outlined for hesperiids (Greeney & Jones, 2003).

Egg. (n=2 hatched shells, 0.9 mm wide). Round to slightly elongate with 11 strong vertical ridges. Eggs were found singly, on the ventral side of mature leaves, both on small *Cecropia sp.* saplings in disturbed areas.

Larva. First instar (n=1, to 3 mm). Head round to roundly square, dark red-brown with sparse dark setae varying in length from minute to short; body roughly round in cross section, entirely clear yellow-orange including prolegs, with darker viscera showing through along midline after the onset of feeding, true legs black; prothoracic shield similar to that described for second instar, T1 with long dark forward-projecting setae and with subspiracular small fleshy lump tipped with several short dark setae; T2 and T3 with small fleshy lumps subdorsally, slighly lower than those on abdomen, slightly larger fleshy lumps spiracularly and smaller lumps subspiracularly as described for T1, all lumps tipped with sparse short dark setae; A1 to A8 with lumps as described for thorax, one subdorsal, one supraspiracular, and one subspiracular, supraspiracular lumps slightly anterior of others, subdorsal lumps on A8 slightly larger than other abdominal lumps and similar in size to subdorsal lumps on T2 and T3; A9 and A10 with lumps supraspiracularly only, anal plate unsclerotized and with sparse fringe of short pale setae. Second instar (n=1, to 8 mm). Head as described for first instar but shining black; body similar in shape to first instar but now orange-green; prothoracic shield shining black, narrow, dorsal only, T1 setae and fleshy lump as described for first instar, several setae arising from prothoracic shield; T2 to A10 as described for first instar, fleshy lumps replaced by short black conical scoli, scoli with short sparse dark setae and tipped with a single long black seta; A9 with small mid dorsal roughly round scoleritized patch with short dark setae, fringe of setae on anal plate pale orange. Third instar (n=2, to 13 mm). Head and body as described for second instars but dorsum of T3 to A7 with irregular bright white frosting, white markings reducing orange-green color to small spots, all scoli as described for second instar but slightly longer and setae near apex paler, shining black scoleritized patch on mid dorsum of A9 now more distinct, anal plate weakly sclerotized, clear. Fourth instar (n=4, to 18 mm). Head and body as described for third instar, white dorsal pattern now extending slighly onto T2 and A8 as stripes on either side of midline, most of larger setae on body and scoli now pale, prolegs with sclerotized shining black plates laterally. Fifth instar (n=11, to 26 mm, Fig. 2). Head as described for fourth instar but now epicranial suture more depressed giving an overall slightly heart shape; body now all velvety black dorsally and laterally, venter dark purple black and all parts of the exoskeleton are the same when stretched (e.g., on T1 during premolt), dorsal bright white pattern very prominent, more defined and not extending onto T2 and A8, becoming pale yellow to bone colored late in instar; T1 still with subspiracular fleshy lump, all scoli prominent and elongate, scoli on T2 (all), T3 (spiracular), A8 (sub and supraspiracular), and A10 (all) tipped clear to pale yellow, remaining scoli entirely clear to pale yellow, color of scoli slightly variable with some individuals having black bases on all scoli and lacking pale tipped scoli altogether. Sixth instar (n=13, to 40 mm). As described for fifth instar. Dorsal markings now bright yellow, broken into rectangles with large black spots, intersegmentally with thin black lines, pattern on T3 now reduced to thin broken line with yellow around base of subdorsal scoli.

Pupa (Fig. 3). Robust, widest at thorax, tapering slightly near head; bright green with scattered black flecking and with prominent, robust black spines, each with dark red markings; 12 spines form a double row along dorsal abdomen, an additional three project laterally from either side, one from the abdomen at posterior margin of wing pads and two from the thorax along the dorsal wingpad margin; thorax produced dorsally into a large spine and two forward-projecting spines adorn the head; cremaster black with variable amount of green, especially dorsally; pupal silk pale brown.

Larval shelters. From abandoned and inhabited shelters found in the field at the time of collection, it appears that larvae make at least three separate shelters during their lifetime. Observations suggest that first instars build an initial shelter and remain there for molts to second and third instars. Third instars build a second shelter part way through the stadia and remain in this shelter for molting to fourth and possibly fifth instar. Sometime late in the fourth or during the fifth instar, larvae build a third shelter and then possibly a fourth. All larvae rest upside down on the ventral surface of the leaf. First shelter (n=2, roughly 10 mm by 10 mm). Following Greeney and Jones (2003), first shelters would be termed "two-cut unstemmed folds." Two major cuts are made from the leaf margin, beginning roughly 10 mm apart and approaching each other at the distal ends only slightly. The cut away section or "lid" is then folded under the leaf along a broad "bridge" and sealed tightly with silk to the ventral surface of the leaf. This forms a roughly square pocket. Feeding during the first, second, and early third instar results in small perforations in the leaf around the shelter and a few on the lid and floor of the shelter. Second shelter (n=4, roughly 15 mm by 35 mm). Second shelters are as described for first shelters, with the two major cuts originating approximately 35 mm apart along the leaf margin and approaching each other at the distal ends only slightly. These also would be termed "two-cut unstemmed folds" (Greeney & Jones, 2003). Once again the shelter lid is folded to the ventral surface of the leaf and tightly silked. Feeding damage creates many large perforations in both the lid and floor of the shelter. Only a narrow section across the middle of the shelter is left unperforated. The larvae rest along this section. Third shelters (n=9, roughly 45 mm by 60 mm, Fig. 4). As described for second shelters, with numerous, relatively smaller perforations. Fourth shelter (n=1 or 2, roughly 70 mm by 115 mm). It is uncertain if the two large shelters observed were in addition to the third shelter. The larger size and presence of empty shelters found nearby (matching the description of third shelters) suggest these are fourth shelters. Both were as described for third shelters.

DISCUSSION

The early stages described here closely match the photographs displayed for *H. dione arcaei* from Costa Rica (Janzen & Hallwachs, 2005). In that database, 13 rearing records are given, 11 on *Urera spp.* (Urticaceae) and 2 on *Cecropia polyphlebia* (Cecropiaceae). These, along with our records reported here, appear to be the first published indication that *Hypanartia* uses hosts in the family Cecropiaceae. The similarities between the caterpillars of *H. d. arcaei* and *H. d. dione* suggest that they may be correctly included within the same species as suggested by Willmott *et al.* (2001).

While we have long known that *Hypanartia* caterpillars construct and rest in shelters built on the food plant leaf, this is the first study to describe the shelters in detail. The similarities in construction and morphology seen between the shelters of *H. d. dione* and some Hesperiidae (Greeney & Jones, 2003) suggest that specific details of shelter architecture may have important ecological implications. In fact, even some of the secondary modifications to the basic shelter plan, most notably the chewing of many small holes or perforations in the shelter walls, is also a characteristic of the shelters of some hesperiids (Greeney & Jones, 2003; Young, 1991). While many functions have been proposed for shelter building by larval lepidopterans (e.g. Damman, 1987; Henson, 1958; Loeffler, 1996; Sagers, 1992; Sandberg & Berenbaum, 1989), we still understand little about the relationship between function and shelter architecture. As evidenced by the diversity of lepidopterans which build larval shelters (DeVries, 1987, 1997; Greeney & Jones, 2003; Scoble, 1992; Stehr, 1987), these retreats surely serve important functions. Undoubtedly we still lack the details and taxonomic understanding of specific shelter-building behaviors, and we suggest that future studies pay more attention to the details of this interesting and widespread behavior.

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